AMERICAN BUILDING BLOCK COMPANY.

REPORT

ON THE

PATENTS AND PROCESSES

IN THE MANUFACTURE OF

The American Building Block.

BY

PROFESSOR E. N. HORSFORD,

Late of Harvard University, Cambridge, Mass.

NEW YORK:

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The elaborate investigations, which have resulted in the accompanying able and comprehensive "Report" on the Patents owned by this Company, were originally commenced in the early part of last summer, by Professor Horsford, of Cambridge, Mass., the celebrated Chemist and Patent Expert, at the instance of some parties at Portland, Maine.

As but a portion of the case was, at that time, submitted to Prof. Horsford, his Report, though fully endorsing us, as far as it went, was necessarily incomplete, and, in our desire to have it made as full as possible, we sought an interview with the Professor, and requested him to continue and complete his researches, including therein all our Letters Patent. This he consented to undertake, after having first consulted with the parties in Portland, above referred to, and we now beg leave to direct your attention to the results obtained.

The high standing of Professor Horsford, as a Chemist and Scientific Expert, is well known to the business community, both here and in Europe, especially in connection

with the application of Science to National Industry, and thus render the conclusions at which he has arrived, after such a protracted and thorough examination of the whole case, all the more interesting and satisfactory to every one, in any way, connected with this most important branch of manufacture — the production of ARTIFICIAL STONE.

GEO. E. VAN DERBURGH,

President.

24 VESEY ST., New York, Jan. 1868.

REPORT.

GEO. E. VANDERBURGH, ESQ.,

President, "American Building Block Co." N. Y.

SIR:

As the result of my examination of your Building Block, and the Patents relating to the invention, I have to report as follows:

RANSOME was the first to cement sand, or other coarsely powdered mineral matter, by means of "water glass," or alkaline silicates. He employed no caustic lime, and specially disclaimed in his Patent the use of all calcined materials.

FOSTER was the first to make Building Stone, by subjecting a mixture of *slacked* lime and moist sand to great pressure, and allowing the moulded forms to harden in the open air.

VANDERBURGH was the first to bring temperature to the aid of *caustic lime*, in its action on moist sand before moulding or pressing.

RANSOME added a liquid cement to materials to be bound together. This cement, by reason of its fluidity, could spread around and encase the component grains of the mass; but the spontaneous action of the carbonic acid of the air, withdrawing the alkali from the silicic acid, deprived the cement of its coherent quality and rendered the stone practically worthless.

FOSTER developed *within the stone* a cement at the surface of the component sand grains, to some extent while mixing, and more after they were moulded and subjected to pressure. He

mixed what may be called *dry freshly slacked lime* with moist sand. Incipient action of the caustic lime on the sand immediately followed, and was increased after pressure, producing more or less of *silicate of lime*, and leaving a certain amount of *hydrate of lime* to harden by further conversion into *silicate of lime*, and by the absorption and combination of carbonic acid and moisture from the atmosphere.

VanDerburgh, by his process, as at present carried out in practical working, intimately mixes *finely ground unslacked lime* with moist sand, in a closed chamber, kept in constant agitation. The affinity of the unslacked lime for water causes the lime dust to adhere wherever it touches the surface of the moist sand. Slacking instantly commences, and is aided by the introduction of steam into this confined space. Under these circumstances, the heat evolved in slacking the lime, as well as the heat due to the steam admitted to the interior of the continuously stirred and kneaded mixture, is brought to bear on the silica, at the surface of the sand grains, in contact with the moist hydrate of lime. After continuing in this condition for a suitable time, it is subjected to great pressure, imparted by successive percussions, in metallic moulds. This process results in a Block,—the surface of which rapidly becomes hard, and the hardness gradually extends from the surface toward the heart of the mass.

Ransome's Patent, of 1844, for the use of "water glass," has expired. The use of alkaline silicates, as such, is open to the world.

Of Foster's Patent I have already expressed an opinion,—both as to its novelty and validity,—and I cannot do better than substantially repeat what I have said.

Foster's Patent is *new*. It differs from common sand and lime mortar in essential particulars. It is a stone, while mortar is a material for binding stones together. The latter cannot be substituted for the former. Foster's Stone owes its distinguishing characteristic to its having been produced under pressure. By means of this pressure and the small proportion of water employed, a product is obtained from common materials, suited

to new and distinct uses, where uniform size and determined form are important—as in the erection of buildings—and in which great density and strength are required. By means of this pressure the sand grains are settled into positions of less mobility, and more surfaces have been brought into contact or close proximity. Within the *stone* there is developed *silicate of lime*, a cement, at the surface of each sand grain and binding it to its fellow. This cement is more effective because of the sand grains. The less the thickness of the layer of cement required the more effective it is. The hardness of Foster's Stone is due in some degree to the formation of hydrate of lime, and double hydrate and carbonate of lime, as in common mortar, and to the formation of *silicate of lime* at the surface of the sand grains, but more to the pressure, which, by reducing the thickness, has increased the effectiveness of the cements. Common mortar, in setting or drying, becomes porous from the escape of surplus water. Through the pores thus left, the carbonic acid of the air enters and forms the double hydrate and carbonate; but, at the same time, prevents the formation of the more tenacious *silicate of lime*.

I have analyzed a series of samples of artificial building stone, made by Foster and others—one of them that had served eleven years as part of a foundation wall, and others of various lesser ages, some of them only a few days old. In the oldest of them only was the lime all combined and rendered substantially insoluble. This sample was nearly as hard as Connecticut River Sandstone. Others of only a few months age were equally hard at the surface, but less firm in the interior. The surface of a freshly made block, exposed to the air, rapidly hardens, while the changes within are slower. A fresh fracture of a block several years old shows a zone of peculiar shade, extending from the outer surface toward the heart of the stone. This zone marks the progress of certain chemical changes which attend the hardening process, and illustrates the fact of the improvement of the stone with age. These changes are accompanied by increase in weight, due to carbonic acid absorbed from the air, and moisture absorbed and combined with the steadily forming *silicate of lime*. I have found, by experiment and analysis, that a block of Foster's building stone, eleven years old, contains from *ten* to *fourteen* times as much silica combined with the lime in the process of

manufacture, and after it was moulded and pressed, as was contained in a fresh block made by the same process. This increased amount of *silicate of lime*, as well as of double hydrate and carbonate of lime, is in keeping, as already suggested, with the observed increased hardness of the stone as it grows older.

The newness of Foster's patent is in the *process* and in the *proportions* of the ingredients he employs, rather than in the character or kind of the ingredients themselves. Of these ingredients he makes a portable stone of definite form, having the same kind of advantage for building purposes that bricks have. The originality and validity of the patent seem to me beyond doubt.

VAN DERBURGH'S invention is the *application of heat* to the mixture of sand and *moist hydrate of lime*, to increase the amount and effectiveness of the cement *before* the blocks are moulded. The *amount* of cement is increased, inasmuch as the production of *silicate of lime* from a mixture of sand, lime and moisture is *facilitated by heat*, as I have demonstrated by experiment, and this has been brought to bear for a length of time before the materials are moulded and pressed. The *effectiveness* of the cement is increased, since the mode of manufacture spreads the cement more uniformly over the surface of the sand grains.

It has been found in practice that blocks made by Foster's process are subject to the condition of the atmosphere, whether moist or otherwise—that is to say, under the influence of a dry atmosphere, immediately after moulding and pressing, they do not harden; whereas blocks made by VAN DERBURGH'S process are not influenced by the hygrometric condition of the atmosphere, but the process of hardening goes steadily and uniformly forward. It is also found, in practice, that by first *slacking* the lime and then mixing it, as a powder, with moist sand, as in the process of Foster, the *slacked lime* does not so effectually and uniformly coat the sand as when the mixture is made with moist sand and finely ground *unslacked* lime, and the whole subjected to heat during the process of slacking, as in the method of VanDerburgh. By slacking the lime in confined space, with, or by means of, the moisture at the surface of the sand grains, the nearness of the *hydrate of lime* formed to the silica, on which it is to act, is

greater, and its chemical affinity is greater, both from the nearness and from the heat due to slacking, and to the admitted steam, than it can be where the hydrate is cold and dry, and encounters moisture at the surface of the sand grains. In the latter case the condition approximates to that of milk of lime and sand, in which, according to Fuchs and Petzholdt, little or no action takes place. In the former, chemical affinity between the silica and lime is aided, not only by the nearness and heat, but also by the *nascent condition* of the caustic lime, at the instant of its slacking, in contact with the sand. In VanDerburgh's process the ingredients enter the block in a more advanced stage of the chemical action that is to result in solidification; more freshly formed *silicate of lime* exists in the block, when moulded and pressed, under VanDerburgh's improved process than under the process of Foster. Microscopic examination shows the individual sand grains in a VanDerburgh block to be coated by a more transparent crystalline cement than is the case in Foster's block. This transparency and crystalline character are evidences of greater tenacity in the cement, because of the greater extent of surface and thickness through which the cement exerts its binding force. They are due in part to the *hydrated silicate of lime*, in part to the double hydrate and carbonate, and, doubtless also, in a fresh fracture, to the crystallized hydrate. This hydrate, on exposure to the atmosphere, absorbs carbonic acid, forming additional double hydrate and carbonate, which imparts greater tenacity and hardness, to the extent of the action, and accounts, for the most part, for the rapid hardening which a fresh surface experiences on exposure to the atmosphere.

I have prepared samples of building blocks from Berkshire sand and chemically pure lime,—as nearly as might be in the laboratory, according to the practical working of VanDerburgh's, and according to the patent of Foster. These blocks, upon analysis, gave the following results:

Silicic acid combined with *lime*, for every hundred parts of quicklime employed—

In VanDerburgh's	5.02
In Foster's	2.76

I have also analyzed a block of VanDerburgh's stone, some twenty months old, and find the proportion of silica—derived from the

sand of the block, by the action of the lime at the time the block was made, and during the period that has since elapsed—to be very large. Assuming the composition of the block to be nine of sand to one of quicklime, I find the proportion of silica, produced by the action of the lime, to be 49.67 for every hundred of lime. This percentage, compared with the silica of a block of VanDerburgh's stone freshly prepared, using chemically pure lime, gives a ratio of 0.7430 : 0.0751, or nearly 10 to 1. Compared with the silica in a block of commercial quicklime, it gives a ratio of about 42 to 1; while Foster's block, eleven years old, gives a ratio in the best specimen of 13.5 to 1.

I have found, by experiment, that a fresh block, made by Foster's process, placed in an atmosphere made artificially dry, does not harden so rapidly, or so thoroughly, as in ordinary atmospheric air, and especially as in moist atmospheric air. I have also found that, in an atmosphere highly charged with carbonic acid, the hardening of the block does not seem to be promoted, if the atmosphere be dry. These results might have been inferred from the general principle that the chemical action of the lime on silica, as well as the absorption of carbonic acid, and its combination with lime, demand moisture. They confirm the results of experience with the Foster Building Blocks, before mentioned, and enable one to see why a Block, in which more *silicate of lime* is formed, at the outset, as in Van Derburgh's, should be less dependent, for its hardness, on the hygrometric condition of the atmosphere.

I regard the practical working under the VanDerburgh patents, as now carried out, *as based upon a new and distinct invention*, producing results decidedly superior to those formerly obtained by the process of Foster.

I have given an opinion to Mr. Strout, of Portland, on the claims of Foster, VanDerburgh, Ransome, Ruschhaupt and other patentees, in which my attention had been drawn to only three, out of seven, of VanDerburgh's patents bearing on the subject. From the language of the patents submitted to me, I did not gain a just conception of VanDerburgh's processes, as practically carried out, and objected to them on account of the apparently great time required, and the moderate production to be expected. I have become satisfied, from actual inspection of the process of

manufacture, that this great time is, in practical working, unnecessary, and that the whole operation is very simple, and permits continuous and rapid mixing, moulding and pressing.

The claims of Van Derburgh, Ransome and Ruschhaupt, to some extent, cover common ground.

VanDerburgh may justly claim :

1st. The slacking of the lime in *contact* with the moist sand, which is to be made into Building Blocks, and, after subsequent dampening, subjecting the mixture to pressure to form Building Blocks.

2nd. The application of heat to a mixture of lime, in the process of slacking, and moist sand, the heat being derived from the slacking lime, or from this and other sources combined, preparatory to pressing into blocks.

3rd. The slacking of the lime in contact with the moist sand in confined space, by which very great heat is brought to the aid of the chemical action of the caustic lime on the silica of the sand.

4th. The subjection to pressure of a mixture of moist sand and lime, slacked in contact with the sand of the mixture, after having been subjected to heat.

5th. The use of a mixture of lime, slacked or unslacked, with sand, with the addition of a liquid silicate immediately before moulding and pressing.

6th. The saturation, with a solution of an alkaline silicate, of blocks made by pressing a mixture of moist sand and caustic lime.

7th. The use of saccharate of lime and soluble *silicates* in the formation of silicate of lime in building blocks.

8th. The use of freshly broken sand grains, to fill interstices between coarser grains, and thus produce a smoother and harder artificial stone.

9th. The application of pressure, by percussion, to a mixture of sand and lime, in whatever form his patents cover.

Ransome patented, in 1844, the use of soluble alkaline silicates, for cementing sand, and other pulverulent mineral matter, specially *excluding* from his claim all calcined materials. That patent

has expired; and the use of soluble silicates, as such, in the composition of artificial stone, is free to the public.

In October 3rd, 1865, Ransome patented the use of alkaline silicates in connection with chloride of calcium, to form silicate of lime in building blocks.

In June 12th, 1866, Ransome patented "the manufacture of artificial stone, cement or plaster, by mixing silicate of soda, or potash, with quicklime and chalk, or sand, or clay, or other similar substance."

RANSOME'S patent of October 3rd, 1865, the distinguishing feature of which is the use of chloride of calcium, in connection with an alkaline silicate, is an original invention.

VANDERBURGH'S patent of July 11th, 1865, for saccharate of lime, in connection with an alkaline silicate, contemplates the use of a lime salt, the action of which is similar to that of chloride of calcium. It is original, and antedates the patent of Ransome by some months.

RANSOME'S patent of June 12th, 1866, for the use of caustic lime with an alkaline silicate, is clearly anticipated by VANDERBURGH in his patent of July 11, 1865, in which he uses a mixture of sand and lime, slacked or unslacked, which, when ready for moulding and pressing, is moistened with a liquid silicate.

RUSCHHAUPT patented, in 1863, the use of quicklime, burned clay and gelatinous silica, as a *cement*. VANDERBURGH, in his patent of 1860, claims the saturation of a block, composed of sand and lime, with a soluble silicate. The specification covers Foster's and other artificial stones or blocks, principally composed of lime and sand. Silicate of lime, as a binding cement, is the substance contemplated in both VanDerburgh's and Ruschhaupt's patents. The one produces it by the decomposition of *silicate of soda*, or *silicate of potash*, with lime; the other by decomposition of *silicate of water*, or *gelatinous silica*, with lime. In practical working, Ruschhaupt's invention has not succeeded, perhaps, because of the presence of burned clay, and also, probably, because of the expense.

As you were the first to apply *percussion* to a mixture of sand and lime, there can be no question of your right to a Patent. You do not patent the machine. One machine, or several machines, may have been patented. Your claim is for subjecting a given composition, prepared in a particular way, to an essential process—to wit: *pressure by means of percussion.* You can allude to the machines you have already patented, and to any equivalent device: it is the *process of hammering or ramming*, the *process of percussion*, in which the effect is many times greater than that produced by simple continuous pressure,—that gives value to your block, not the particular machine by which it is effected. The language of your claim might be something like this: I claim the pressing of these materials, prepared as above described, in moulds by the process of *percussion.*

Respectfully submitted,

E. N. HORSFORD.

CAMBRIDGE, Mass., Dec. 27, 1867.